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ABSTRACT

In many school districts throughout the country, the unplanned and inequitable distribution of computers has tended to widen the gap between advantaged and disadvantaged, male and female, and majority and minority students. One of the missions of the Maryland State Department of Education (MSDE) is the task of achieving equality of educational opportunities for all students within the state. With this in mind, MSDE, local education agencies in Maryland, and computer hardware and software vendors initiated a collaborative instructional support project called the Maryland Education Technology Network (METN) to provide equitable distribution of computer technology and access to educational support for schools that lacked these resources. Results of three years of evaluation studies of the METN project show a steady increase in the number of schools served by a network-computer center, positive student attitudes toward computerized instruction, and positive teacher attitudes toward using computers for instructional support and as instructional tools. The copy of the 60-item computer-using teacher survey that is provided includes a tally of the responses for each question. (5 references) (DB)

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PROMOTING EQUITY THROUGH EDUCATIONAL TECHNOLOGY NETWORKS

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A paper presented at the annual meeting of
The American Educational Research Association

Boston, MA April 1990

Maryland State Department of Education
Baltimore, Maryland

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PROMOTING EQUITY THROUGH EDUCATIONAL TECHNOLOGY NETWORKS

A Summary

In many school districts throughout the country, the unplanned and inequitable distribution of computers has tended to widen the gap between advantaged and disadvantaged, male and female, and majority and minority students. One of the missions of the Maryland State Department of Education (MSDE) is the task of achieving equality of educational opportunities for all students within the state. With this in mind, MSDE, local education agencies (LEAs) in Maryland, and computer hardware and software vendors initiated a collaborative instructional support project called the Maryland Education Technology Network (METN) to provide equitable distribution of computer technology and access to educational support and enhancement systems for schools that lacked these resources.

Statewide distribution of resources and results of three years of evaluation studies of the METN project are reported in this paper "Promoting Equity Through Educational Technology Networks." Analysis of schools with access to networked computers indicates many of these schools are in rural areas with relatively small per pupil expenditures. The report describes students' attitudes toward computers as learning tools, including a breakdown of responses by sex for each of the three consecutive years of the student survey. Also reported are teachers' attitudes toward computers as instructional tools.

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I. Introduction and Background

Among the many varied functions of state and local departments of education, one that stands out as the chief reason for the establishment and maintenance of these organizations (their so called "raison d'etre") is their role in providing equality of educational opportunities for the people of the state/region they serve. Other institutions and agencies may be just as capable (though not necessarily as cost-effective) in developing and monitoring curricular and instructional operations. In a number of states, the function of evaluating the outcome of schooling by testing and other assessment measures is entrusted to non-profit or commercial organizations. However, the process of equitable distribution of resources and overseeing the administration of public educational programs so as to ensure the provision of equality of educational opportunities for all students, require the establishment of such central agencies as the state department of education.

In recent years, the development of computer technologies has had a revolutionary effect on society. Computers have become an integral component of just about all commercial and industrial operations. These days, personal computers (PCs) are not only used in occupational settings, but are fast becoming an indispensable household equipment in an ever growing number of homes. However, having been primarily developed for non-school settings, computers are often placed in schools without planning or direction either in the acquisition or use of the technology.

In many school districts throughout the country the unplanned and inequitable distribution of computers has tended to widen the gap between advantaged and disadvantaged, male and female, and majority and minority students.

A number of studies point out the existence of inequities both in access to computers and in learning based on computer assisted instruction (e.g., DuBois & Schubert 1986). Others find evidence of inequality of computer training programs for male and female students, where boys were found in computer programming classes and girls in word processing classes (Luehrmann 1985). This study points out evident inequality of treatment in both curricula and computer access, based on student's socioeconomic status (SES). Another study warns that such differential treatment will increase gender and socio-ethnic inequities in the labor market (Miura & Hess 1984).

Alerted by such observations and concerned with the potential consequences of uncontrolled direction in the development of school-based computer technology, the State of Maryland decided to act promptly and effectively. In 1985, then Maryland's State Superintendent of Schools, David W. Hornbeck appointed a task force to examine the issue of computerized education and suggest developmental directions and procedures. The task force was specifically asked to address the state's venues for providing equality of educational opportunities for all Maryland's students (Sullivan 1986).

It is generally acknowledged that while some of Maryland's local education programs are among the best in the United States, the funding for their educational programs is dependent on local budgets and ultimately on the county's wealth. Local wealth varies from one suburban county that is ranked among the richest in the nation, to poor, sparsely populated, agrarian counties.

Based on the task force's suggested plan of action and full consideration of budgetary contingencies and constitutional mandates, the Maryland State Department of Education (MSDE) initiated a collaborative instructional support project called the Maryland Education Technology Network (METN). A large number of local education agencies (LEAs) throughout Maryland offered their full support and cooperation with the implementation of the METN program.

METN's initial objectives were threefold. It was designed so as to provide an equitable distribution of computer technology and access to educational support and enhancement systems for schools that lacked these resources. To accomplish this objective, it was necessary to use computers in the most efficient assembly system. This meant instead of using stand-alone PCs, they would devise computer assemblies in a network configuration. The development of centers in schools that were badly in need of technological resources, thus became the second objective. In these centers, computer equipment would be used in a network configuration and school staff and teachers would be trained to operate and use these centers. Thirdly,

MSDE's long range plans called for the development of long distance transmission of data, information and instructional software from a central resource library to school centers throughout the State. The achievement of this objective would open the door to a vast array of potentialities for expanding students' horizons of educational experience (METN Goals and Objectives 1985).

Since its inception at the beginning of the school year 1986-87, the program has made great strides toward the achievement of the first two goals. In less than three years 429 centers have become fully equipped and operational. Almost all of these centers are founded so as to satisfy METN's objective of equity of educational opportunity.

II. Purpose of the Study

Since the beginning of the METN operation, it was decided that annually the achievement of equity, the functional effectiveness of networking centers, and the need for improvement and modification of the operation should be studied. This paper is based on the results of the evaluation of the implementation of the METN program for three consecutive years of these centers' operations. In the first year's study four different questionnaires were given to students, center coordinators and teachers (both those who used the centers and worked with computers and those who didn't). At the end of the second year of operation, a different group of schools were chosen to respond to the questionnaires, and this time only students and computer

using teachers were asked to respond. The third year's study was a replication of the second year with some schools from the first and second year combined with a larger percentage of students from new centers. Since four items on the students' questionnaires were slightly modified, the three-year comparative study will be based on the core of items common to these questionnaires. As indicated earlier, the purpose of the study was to do the following:

A. Investigate the extent of METN's effectiveness to provide an equitable distribution of educational technology for schools that lacked these resources.

B. Assess the students' attitude toward using computers as learning tools, and in particular investigate the possible differential effect of this technology on male and female students. Since many schools involved in the study did not provide adequate race/ethnicity data, we decided to defer the question of equality of opportunities for racial groups to a future investigatory study.

C. Assess teachers' attitudes toward computers as instructional tools and their perception of the effectiveness of their METN network lab for students of different abilities.

III. Computer Centers: Physical & Organizational Description

Most of these centers are physically located in a large centralized area with adequate space for the placement of at least 32 desks or tables providing 32 locations. Each desk supports a personal computer. A file server is installed on a separate desk, and the center coordinator/teacher has a workstation. Although the 30-station central computer classroom is common, it is not the only configuration used by METN sites. Many labs have fewer than 30 workstations, and some schools have chosen to distribute a small number of workstations to many classrooms within the building.

Whether in one room or more than one, workstations are connected in a network configuration (APPENDICES A1 & A2). They run from a file server using appropriate cabling and network software. The hardware and software network configuration may be from any of the major computer companies. METN networks include IBM/Novell, Unisys/Icon, Apple/Appleshare, Corvus or Digicard, and Tandy/3COM configurations. Programs such as IBM's ICLAS, Digicard's Mandrake, and Tandy's SchoolMate are used to manage network software. IBM hardware and its appropriate networking software are prevalent because IBM donated a sizable quantity of equipment to a number of centers through a large educational grant. As shown in these figures, larger extended networks can be formed with the use of additional file servers. Other technologically advanced instructional equipment such as CD-ROM or interactive videodisc may be connected to the network.

IV. Financial Resources and Business Partnerships

The METN pilot began in 1985 with commitments from IBM and Unisys to install networked labs in several schools across the state. These first labs required matching funds from each school to cover the cost of implementation and software. IBM installed 30-workstations labs of PCjrs in five schools (one each in Baltimore City, Charles County, Queen Anne's County, St. Mary's County, and Washington County). Unisys installed two labs (one each in Hartford and St. Mary's Counties). In late 1986, Apple Computer committed to providing a pilot lab to be installed in Caroline County. By 1987, networked computer classrooms were being integrated into the curriculum at all grade levels (1-12), in geographically diverse areas (urban, suburban, and rural), and in areas of the state having some of the lowest wealth per pupil.

As the value of networked classrooms became evident and as more quality software became available for networks, interest throughout the state's schools increased rapidly. Interest from businesses for school technology partnerships also increased. One of the first major partnerships was established in 1987 between Potomac Edison Power Company, the schools in its service area, and MSDE.

The Potomac Edison service area of Maryland includes six counties in the western part of the state (Allegany, Carroll, Frederick, Garrett, Montgomery, and Washington). With a commitment to provide Apple IIgs computers and a Digicard file

server, Potomac Edison asked interested LEAs (Local Education Agencies) to prepare a classroom to receive the equipment at selected schools and to allocate funds for software and teacher training. Interest in this program has been so great that during its first three years (1987, 1988, 1989) 82 public schools plus 8 colleges were equipped with Digicard networks from Potomac Edison donations in excess of one million dollars.

Other business partnerships also became an effective means of providing technology to schools. Baltimore Gas and Electric, a power company serving the central part of the state, worked closely with a Baltimore inner city school to help them determine and meet their computer needs. A donation of over $75,000 was made to allow this school to install an IBM network consisting of 30 IBM Model 25 workstations with a Model 80 file server. Likewise other schools have sought business partnerships and, on a smaller scale, have succeeded in supplementing their technology programs.

State and federal money has also been used to help the less affluent areas of the state achieve technological equity. Several LEAs decided to use large portions of their Chapter 2 money for classroom computer equipment. MSDE made annual grants available to assist in the areas of technical needs and staff training for technology. In 1989, the state legislature appropriated one million dollars for networked computer classrooms in the seven counties comprising the Rural Schools Enhancement Project. These seven counties (Allegany, Caroline,

Number of Respondents in Each Academic Year by School Level

	1986-87				1987-88				1988-89			
Respondents	Elem.	Mid.	High	Total	Elem.	Mid.	High	Total	Elem.	Mid.	High	Total
Students	401	948	776	2125	515	961	245	1721	1338	488	2105	3931
Computer Using Teachers	33	46	60	139	11	40	17	68	40	28	68	136
Non-Computer Teachers	13	59	46	118	NA	NA	NA	NA	NA	NA	NA	NA
Site-Coordinators	2	5	4	11	NA	NA	NA	NA	NA	NA	NA	NA

TABLE I

Cecil, Dorchester, Garrett, Somerset, and St. Mary's), in addition to being rural, also represented areas with low wealth per pupil.

By the end of the school year in 1989, 429 schools across the state had networked computers in the building for instructional purposes. Some of the LEAs with very favorable student/computer ratios were those with little money traditionally available to provide these kinds of services to their students.

V. Methodology

At the end of the first year of operation, four separate survey instruments were developed and disseminated to students, computer using teachers, non-computer using teachers, and site coordinators. Responses were collected from 2,125 students. After the second year of operation, questionnaires were given to students and computer using teachers from nine schools with new networking labs. Responses were collected from 1721 students, and 68 computer using teachers. Last year, 21 schools were surveyed: 3,931 students and 136 computer using teachers responded (Table I).

Students' questionnaires were designed to assess students' attitudes toward computerized instruction. During the first two years, 16 identical items were used. During the 1988-89 school year, with the involvement of the Potomac Edison schools, four items changed. This report used the 12 items that are common to

all three surveys. Computer using teacher' questionnaires for all three years contained 60 identical items. Teachers were asked to evaluate the use of the computer as an instructional tool in general and for different ability groups in particular, as well as the overall effectiveness of the METN program.

VI. Findings

A. Equitable Distribution of Resources

Table II shows that by the end of the school year 1988-89, the number of schools that were served by network-computer centers had reach 429, or more than 1/3 of all public schools in the State of Maryland had established such centers with the assistance of METN. The same table also shows that per pupil expenditure varies greatly among the 24 school districts. The difference between Montgomery's $6,112 per pupil expenditure and Caroline's $3,761 can be seen as a cumulative difference of close to 60,000 dollars at classroom level (for class size of 25) and more than $700,000 for schools of 300 students. The difference represents potential inequality of resources of all kinds including access to computer technology. As Table II illustrates, most of the 429 centers are established primarily in rural areas with relatively small per pupil expenditures. As related earlier in Section IV, in these districts most or all of the schools were helped with the establishment of a network computer center. Examples of rural areas with a center in each school are Allegany, Calvert and Caroline. While at this time the number of centers in Baltimore City is rather limited, in an

TABLE II

Statistics About Maryland's School Districts

School Districts	Number of Schools	Wealth per Pupil	Expense per Pupil	Number of Computers	Number of Schools with Network	Students per Computer	Students per Staff
State Total	1201			31,863	429		
Average		$151,492	$4,650			22	13.1
Allegany	24	101,092	3,912	742	24	15	13.8
Anne Arundel	111	148,250	4,467	1,955	27	33	13.5
Baltimore City	180	92,727	3,966	1,383	9	78	13.4
Baltimore	146	202,283	5,162	2,673	4	31	12.8
Calvert	15	163,428	4,155	635	14	15	13.5
Caroline	9	81,254	3,761	289	9	16	12.3
Carroll	31	112,469	3,893	882	8	24	14.2
Cecil	25	92,931	3,932	470	5	27	13.4
Charles	27	111,038	4,012	899	20	20	13.5
Dorchester	11	107,732	4,174	252	1	20	12.5
Frederick	42	110,740	3,992	1,295	36	20	13.5
Garrett	17	91,935	3,862	484	11	11	10.8
Harford	42	109,379	3,870	1,029	28	29	13.6
Howard	45	172,209	5,073	1861	5	15	11.9
Kent	8	148,225	4,713	143	0	17	11.6
Montgomery	162	253,442	6,112	6,323	16	16	11.9
Prince George's	172	140,147	4,799	7,135	172	15	13.9
Queen Anne's	9	140,136	4,444	325	2	16	14.0
St. Mary's	27	102,242	4,185	461	5	27	14.0
Somerset	13	80,862	3,830	232	4	15	12.7
Talbot	9	202,283	4,343	194	0	20	12.3
Washington	42	113,856	4,181	1,144	28	15	12.9
Wicomico	22	106,503	3,883	639	1	19	12.9
Worcester	12	319,353	5,032	418	0	13	10.6

Students per Staff represents the number of students for each member of the instructional staff - including teachers, principals, aides and counselors.

urban fringe area such as Prince George's, each of the 172 schools is equipped with a center. METN has made impressive progress toward its goal of providing equality of resources. It has invested innumerable number of hours in training the staff and teachers of these schools in the art of effective operation of these centers and has added an average of 143 schools to the list each year. If this rate of increase is maintained, within a few years every public school in Maryland will be equipped with a networking center.

B. Students' Attitudes Toward Computers as Learning Tools

Comparative analysis of the three surveys indicates that students' responses were highly reliable (Table III). Analyses of these responses indicate that students' attitudes toward computerized instruction in general and their experiences in the network environment in particular were very positive. Charts 1 to 3 illustrate their responses to the common questions. These show that the majority of students prefer learning in a computerized instructional environment to traditional instructional settings.

On the whole third year respondents were even more positive than first and second year respondents. Close to 80% of first and second year respondents felt that computer assisted instruction (CAI) was useful in learning math. In the third year, this percentage was increased to 86%. Close to 84% of first and second year respondents agreed that learning with computers is fun, while 87% of third year agreed with this

METN

	RESULTS	1987 (N-2125)	1988 (N-1721)	1989 (N-3931)
		"USEFUL FOR LEARNING MATH"		
Q1	AGREE	76.5%	78.1%	86.1%
		"FIGURING OUT WHICH BUTTON"		
Q3	DISAGREE	65.7%	70.3%	76.3%
		"FEEL LIKE OWN PRIVATE TEACHER"		
Q4	AGREE	66.0%	65.0%	58.5%
		"TAKING A TEST UNCOMFORTABLE"		
Q5	DISAGREE	49.8%	53.0%	32.4%
		"MAKE IT EASIER TO LEARN"		
Q6	AGREE	57.0%	60.2%	75.4%
		"FEAR OF COMPUTERS"		
Q9	DISAGREE	89.2%	88.1%	90.3%
		"GET BORED WORKING BY MYSELF"		
Q11	DISAGREE	64.3%	62.2%	66.7%
		"LIKE NO ONE SEEING MY MISTAKES"		
Q12	AGREE	48.0%	49.3%	48.4%

TABLE III

		"LEARNING WITH COMPUTERS IS FUN"		
Q13	AGREE	83.6%	83.8%	86.8%
		"DO NOT GET ENOUGH TIME"		
Q14	AGREE	68.1%	66.9%	44.5%
		"WRITING IS MORE DIFFICULT"		
Q15	DISAGREE	60.6%	59.3%	57.9%
		"LIKE TO USE FOR MORE CLASSES"		
Q16	AGREE	79.2%	81.7%	84.8%

statement. Although a majority of respondents agreed that computers made learning easier, in the third year their proportion had increased to 75%. Students continued to like the privacy computers offered in masking mistakes from public scrutiny, and many felt that the networking system operated like their own private teacher. Only 6% of students indicated that they were afraid of working with computers.

When students' responses were factor analyzed, three factors emerged as follows:

1. Uncomfortable Working With Computers
   This factor was based on the following items:

   Item 9 - I am afraid of working with computers.

   Item 15 - Writing with a computer is more difficult than using paper and pencil.

   Item 3 - I spend more time trying to figure out which button to press on the computer than learning the material.

   Item 5 - I feel uncomfortable when I am taking a test on the computer. (If applicable)

   Item 11 - I get bored working by myself at the computer.

2. Preference for Traditional vs. Computerized Learning
   Item loading on this factor was as follows:

   Item 6 - Computers make it easier for me to learn.

   Item 4 - I feel like I have my own private teacher when I am using the computer.

   Item 1 - Computers are useful for learning math.

3. Enjoys Working with Computers
   This factor consisted of the following items:

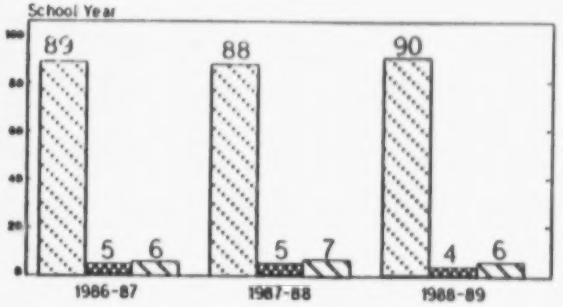
   Item 14 - I don't get enough time on the computer.

   Item 12 - I like working on the computer because no one can see my mistakes.

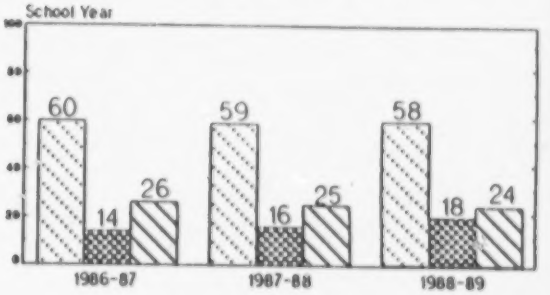
UNCOMFORTABLE WORKING WITH COMPUTERS

Disagree | Undecided | Agree

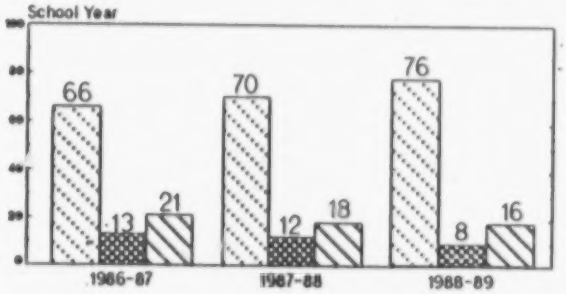
I am afraid of working with computers.



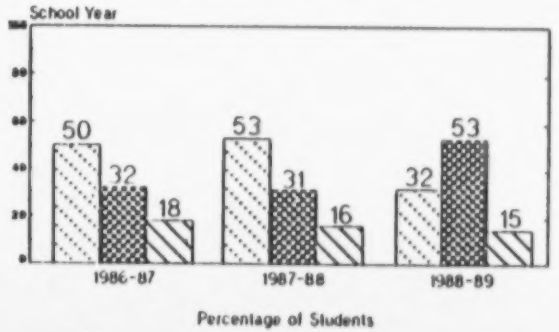
Writing with a computer is more difficult than using paper and pencil.



I spend more time trying to figure out which button to press.



I feel uncomfortable when I am taking a test on the computer.



I get bored working by myself at the computer.

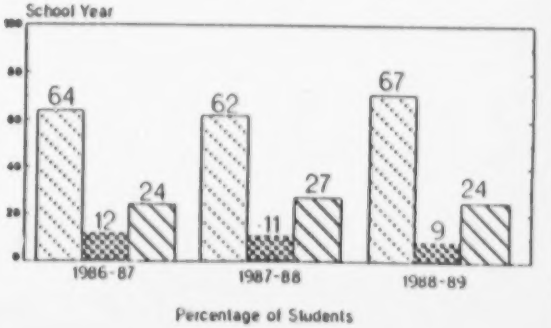
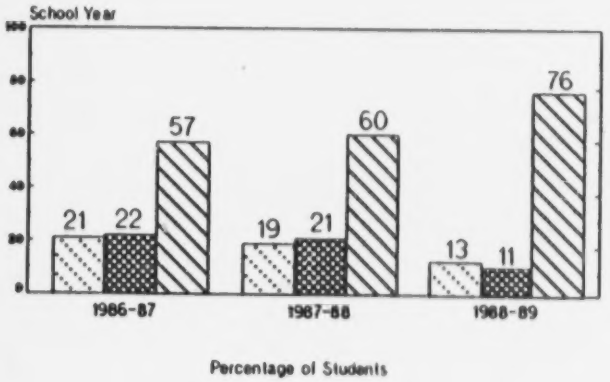


CHART 1

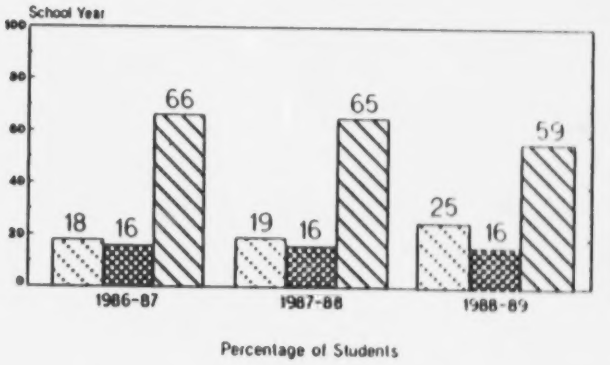
PREFERENCE FOR TRADITIONAL VS COMPUTERIZED LEARNING

Disagree Undecided Agree

Computers make it easier for me to learn.



I feel like I have my own private teacher when I am using the computer.



Computers are useful for learning math.

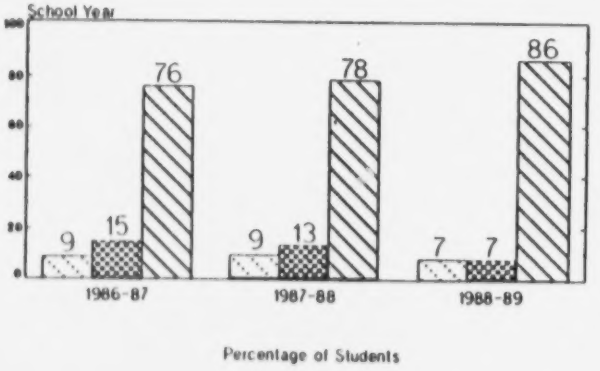


CHART 2

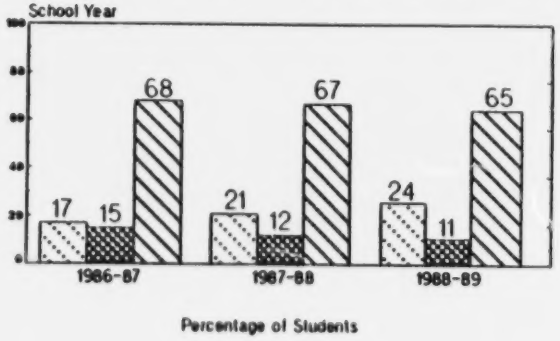
27

28

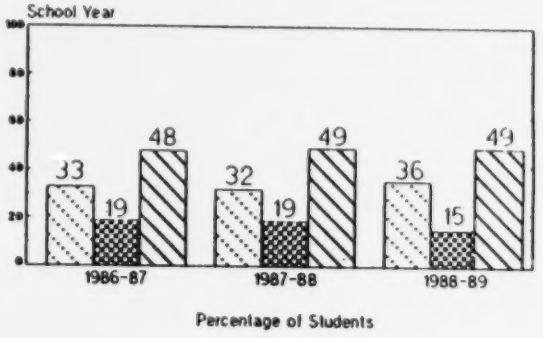
ENJOYS WORKING WITH COMPUTERS

Disagree Undecided Agree

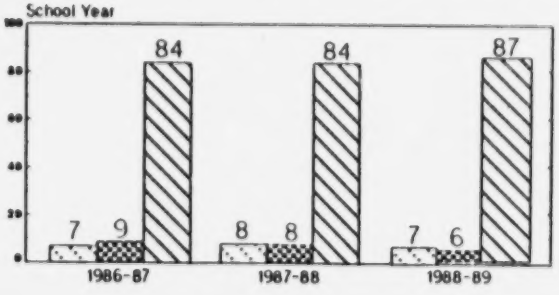
I don't get enough tiime on the computer.



I like working on the computer because no one can see my mistakes.



Learning with computers is fun.



I would like to use computers for more of my classes.

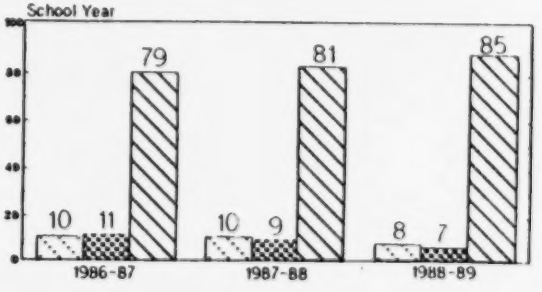


CHART 3

Item 16 - I would like to use computers for more of my classes.

Item 13 - Learning with computers is fun.

As measured by the level of students' responses, the METN program has been very successful. Students in general are comfortable working with computers, prefer computerized instruction to traditional modes, and enjoy working with computers.

In Part A of this section, we discussed METN's efforts to overcome inequality of technological resources, and pointed out that a good deal of progress had been made toward achieving that objective. Another important objective of the METN's program was to ensure that the introduction of computer technology to schools did not lead to inequitable access to its advantages for students of different sex.

Students' responses to each of these three consecutive surveys are broken down by sex and shown in Tables IV, V, VI. Each table represents responses aggregated into one of three above mentioned factors. A striking feature of all three tables is the level of consistency of response patterns for different groups of students and different survey years. This observation brings a significantly high measure of reliability to our findings. Results shown in these tables indicate that there is little difference between the boys' and girls' responses to networked computerized instruction. Measured for their enjoyment of working with computers, the results shown in Table IV indicate that female students are slightly more enthusiastic than male

METN STUDENTS' SURVEYS

ENJOYS WORKING WITH COMPUTERS

SEX	DISAGREE		INDIFFERENT		AGREE	
1986-87 (N=2125)	N	%	N	%	N	%
MALE	35	4.9	152	21.2	530	73.9
FEMALE	35	4.3	282	16.0	645	79.6
CHI-SQUARE 7.33479	D.F. 2		SIGNIFICANCE .0255		MISSING 598	
1987-88 (N=1721)	N	%	N	%	N	%
MALE	48	6.1	144	18.2	601	75.8
FEMALE	30	3.7	129	16.0	649	80.3
CHI-SQUARE 6.68127	D.F. 2		SIGNIFICANCE .0354		MISSING 120	
1988-89 (N=3931)	N	%	N	%	N	%
MALE	78	4.4	333	18.6	1380	77.1
FEMALE	57	3.5	308	18.9	1262	77.6
CHI-SQUARE 1.64682	D.F. 2		SIGNIFICANCE .4389		MISSING 513	

TABLE IV

METN STUDENTS' SURVEYS

UNCOMFORTABLE WORKING WITH COMPUTERS

	SEX	DISAGREE		INDIFFERENT		AGREE	
1986-87 (N=2125)		N	%	N	%	N	%
	MALE	379	65.7	171	29.6	27	4.7
	FEMALE	469	70.1	155	23.2	45	6.7
CHI-SQUARE 8.08832		D.F. 2		SIGNIFICANCE .0175		MISSING 879	
1987-88 (N=1721)		N	%	N	%	N	%
	MALE	527	66.7	202	25.6	61	7.7
	FEMALE	587	72.9	174	21.6	44	5.5
CHI-SQUARE 7.92873		D.F. 2		SIGNIFICANCE .0190		MISSING 126	
1988-89 (N=3931)		N	%	N	%	N	%
	MALE	1041	68.4	419	27.5	63	4.1
	FEMALE	1022	75.4	286	21.1	48	3.5
CHI-SQUARE 17.66519		D.F. 2		SIGNIFICANCE .0001		MISSING 1052	

TABLE V

METN STUDENTS' SURVEYS

PREFERENCE FOR TRADITIONAL VS COMPUTERIZED LEARNING

SEX	DISAGREE		INDIFFERENT		AGREE	
1986-87 (N=2125)	N	%	N	%	N	%
MALE	205	28.5	369	51.3	146	20.3
FEMALE	260	31.7	418	51.0	142	17.3
CHI-SQUARE 3.13146	D.F. 2		SIGNIFICANCE .2089		MISSING 585	
1987-88 (N=1721)	N	%	N	%	N	%
MALE	241	29.8	418	51.7	150	18.5
FEMALE	232	28.0	467	56.3	131	15.8
CHI-SQUARE 3.90052	D.F. 2		SIGNIFICANCE .1422		MISSING 82	
1988-89 (N=3931)	N	%	N	%	N	%
MALE	537	29.2	970	52.7	333	18.1
FEMALE	527	31.6	889	53.4	250	15.0
CHI-SQUARE 6.82110	D.F. 2		SIGNIFICANCE .0330		MISSING 425	

TABLE VI

students, but on the whole, both groups are very positive in their responses. According to Table V approximately 6% or less of either group feel uncomfortable working with networked computer labs, and more than 2/3 of both male and female students deny any discomfort. Again the female students show slightly more positive attitudes toward computers than their male classmates. Therefore, it is not surprising to see in Table VI that a relatively greater proportion of girls prefer the computerized instruction (versus traditional instruction) than boys, even though the difference is hardly significant. An important outcome of our observations is that we can now say with confidence that networked computerized instruction does not effect female students in a disadvantaged fashion. If anything, it is the much needed equalizer for girls.

C. Teachers' Attitudes Toward Computers as Instructional Tools

Computer-using teachers were also very positive in their appraisal of CAI with network facilities. Table VII provides results of teacher surveys for three school years: 1986-87, 1987-88, and 1988-89. The responses for the effectiveness in providing instructional support, (84%, 85%, and 96%), and the value to the participating teachers as an instructional tool (81%, 93%, and 96%) were increasingly more positive. When asked to respond to the statement "only the more able students benefited from the networking system", the majority disagreed (69%, 90%, and 92%).

Certain items were designed to directly compare computer vs. traditional teaching. When teachers were asked their preference in teaching to students of different abilities, (66%, 51%, and 69%) preferred computers, with (16%, 27%, and 15%) responding that computer and traditional teaching was the same. Less than 18% in any year preferred traditional. In terms of using the computer to provide remedial assistance, the responses were even more positive (69%, 62%, and 72%).

Teachers felt that learning had increased for average students (57%, 46%, and 56%), and for below-average students, (65%, 54%, and 69%). Also the majority felt that learning opportunities had increased for the academically gifted (79%, 62%, and 64%), and for students with learning disabilities or handicaps (73%, 59%, and 71%).

VII. Observations and Conclusions

This three-year survey/evaluation has been combined with close observation of the sites where computer network labs have been installed. Additionally many teachers and site coordinators have been interviewed at these centers. This overall effort has provided much valuable data regarding the operation of the networking centers, and a good deal of information has been generated about where improvements are needed and what are some of the functional limitations of the METN program. The need for staff training development is most obvious. Teachers want to learn more about using the instructional technologies in a more effective way and expand their own capabilities in using the

computer and fully exploit its potentials. Many express the need to use computers as tools for their own writing and bookkeeping. In instances where teachers have been provided help in learning word processing, for example, the use of the computer center has greatly increased. However, even in areas where teachers have felt inadequately prepared, students' attitudes and reactions have been very positive toward their CAI experiences.

With the gradual increase in experience and knowledge, teachers and site coordinators have gained a much broader understanding of a variety of uses for the networking centers. They see the network's advantages in terms of its ease of use, and its stimulation of student's interest. They find the management systems allow them to easily individualize student programs, and they have discovered that students of varied ability levels can simultaneously work together and learn and progress at their own speed. Efforts to integrate broader use of computers into curriculum have greatly increased. In several schools the impact has been significant enough to bring forth a firm commitment by the administration to expand the computer network to the point of achieving a better than 10 to 1 student-to-computer ratio. It is expected that with the provision of additional computers, students will be able to regularly use computers in all subject areas.

What is most encouraging is that we have seemingly found a way of providing equality of access to educational technology for all students in public schools. We are yet far from achieving

equality of educational opportunities for all children, but this study shows that the proper introduction of computer technology could in fact become an effective means of reaching this goal. Teachers' responses indicate that networked computerized instructional environments provide the most effective approaches to the problem of bridging the gap between educationally disadvantaged students and their cohorts. Prolonged exposure and access to this instructional tool may change what is often a distasteful, frustrating and humiliating experience for those students into a positive, confidence building and rewarding one.

Already the METN centers have proven themselves as valuable instructional tools. The next step in the process of full justification of the expenditure and allocation of resources is relating students' growth in learning and achievement to the use of the centers. This is understandably a more complex and time consuming undertaking. At this time plans for a longitudinal study of the METN program and its educational effectiveness are being completed. Now that equipment is in place and the centers are off and running, it is time to prove that they are truly effective.

COMPUTER USING TEACHER SURVEY - METN

1. The METN computer system has been effective in providing instruction support.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989		1.5	3.0	34.8	60.7
1988		2.9	11.8	38.2	47.1
1987	4.3	3.6	7.9	39.6	44.6

2. The computer system has been effective in providing planning resources for teachers and administrators.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	1.5	9.1	18.9	42.4	28.0
1988	2.9	2.9	27.9	38.2	27.9
1987	4.4	5.8	22.6	43.1	24.1

3. Operationally, the computer system has been reliable.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989		5.9		37.5	56.3
1988	4.4	2.9	14.7	50.0	27.9
1987	2.2	9.5	6.6	61.3	20.4

4. The technical support given to the computer system is adequate.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	.8	3.0	8.3	37.8	56.3
1988	2.9	1.5	26.5	44.1	25.0
1987	3.0	7.4	14.8	54.1	20.7

5. The METN computer system is superior to other computers available for classroom

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	.8	3.8	55.0	20.6	19.8
1988	5.9	10.3	47.1	22.1	14.7
1987	6.0	5.2	41.8	25.4	21.6

6. The computer system's storage space is adequate for our instruction needs.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	1.5	6.0	18.0	43.6	30.8
1988		8.8	32.4	36.8	22.1
1987	5.1	12.4	26.4	40.9	21.2

7. Additional training sessions should be provided for teachers.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989		7.4	4.4	46.7	41.5
1988	1.5	7.4	8.8	44.1	38.2

8. The resources/materials used in training programs were satisfactory.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989		7.8	10.9	63.3	18.0
1988	1.5	13.4	23.9	53.7	7.5
1987	2.2	5.8	14.6	62.8	14.6

9. At our school the METN computer facilities are being used less than what would have been expected a year ago.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	48.1	32.6	11.1	5.9	2.2
1988	47.0	31.8	13.6	4.5	1.5
1987	38.7	38.0	11.7	7.3	4.4

10. Our school has too few computers for students to have sufficient time to learn.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	11.0	39.7	9.6	30.1	9.6
1988	16.4	29.9	7.5	29.9	16.4
1987	10.1	36.7	13.7	20.9	18.7

11. We can't afford the cost of software that would adequately serve our needs.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	.8	29.5	28.8	31.8	9.1
1988	7.5	19.4	49.3	17.9	6.0
1987	9.5	35.0	34.3	17.5	3.6

12. There are better ways to provide instruction than with the use of computers.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	2.3	48.8	17.1	29.5	2.3
1988	17.9	31.3	25.4	23.9	1.5
1987	16.9	40.4	26.5	14.0	2.2

13. The amount of software available on the METN system is adequate.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	6.6	39.0	20.6	31.6	2.2
1988	10.3	30.9	30.9	25.0	2.9
1987	11.6	26.8	27.5	30.4	3.6

14. The content of the software available on the METN system is appropriate.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	.7	19.3	11.1	61.5	7.4
1988	1.5	13.2	35.3	47.1	2.9
1987	5.1	14.5	18.1	52.9	9.4

15. Using the METN system has been valuable to the participating teachers an an instructional tool.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989			4.5	49.3	46.3
1988		2.9	4.4	52.9	39.7
1987	2.9	5.0	10.8	49.6	31.7

16. Using the METN system has been valuable to the participating teachers as an administrative tool.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	5.4	10.9	30.2	36.4	17.1
1988	2.9	5.9	39.7	38.2	13.2
1987	8.2	12.7	36.6	28.4	14.2

17. Only the more able students can benefit from a networking system.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	58.8	33.1	5.1	1.5	1.5
1988	62.7	26.9	9.0	1.5	
1987	33.6	35.0	21.2	6.6	3.6

18. Use of a networking system as an instructional tool will alter the teaching style of many teachers.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	2.2	25.9	25.2	41.5	5.2
1988	8.8	22.1	27.9	39.7	1.5
1987	2.9	22.3	28.1	28.8	18.0

19. In general, as long as students have access to computers, it doesn't matter if it is with a networking system or stand-alone computer.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	9.7	35.1	17.2	35.1	3.0
1988	15.2	45.5	15.2	18.2	6.1
1987	10.8	22.3	28.1	28.1	10.8

20. It is best if teachers have all their students at the computers working on the same lesson at the same time.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	11.9	52.6	10.4	18.5	6.7
1988	18.2	42.4	15.2	22.7	1.5
1987	6.5	43.5	17.4	20.3	12.3

21. In our school, students usually use the same software packages at the same time.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	3.0	17.9	23.9	50.7	4.5
1988	4.4	11.8	26.5	50.0	7.4

22. Students with computers and printers at home have an unfair advantage over other students.

% SURVEY	strongly disagree	disagree	undecided	agree	strongly agree
1989	9.8	36.8	21.8	31.6	
1988	13.4	44.8	25.4	13.4	3.0

23. Students/Staff use the word processor to write articles/ research papers.

% SURVEY	never	rarely	sometimes	most of time	always
1989	47.2	10.6	26.0	9.8	6.5
1988	10.6	12.1	30.3	28.8	18.2
1987	29.6	12.6	28.9	35.9	3.0

24. Students/Staff use the word processor to make class products like a book/newspaper.

% SURVEY	never	rarely	sometimes	most of time	always
1989	64.2	15.4	13.8	3.3	3.3
1988	33.3	18.2	27.3	9.1	12.1
1987	56.0	15.7	15.7	8.2	4.5

25. Students/Staff use the word processor for planning/ administrative use.

% SURVEY	never	rarely	sometimes	most of time	always
1989	41.1	11.3	25.8	10.5	11.3
1988	22.7	19.7	31.8	13.6	12.1
1987	40.4	11.0	26.5	17.6	4.4

26. Students/Staff use the word processor for preparation of instructional materials.

% SURVEY	never	rarely	sometimes	most of time	always
1989	21.1	14.3	39.1	17.3	8.3
1988	25.8	15.2	36.4	16.7	6.1
1987	25.7	11.0	35.3	22.8	5.1

27. Drills to help students practice vocabulary or skills.

% SURVEY	never	rarely	sometimes	most of time	always
1989	10.4	9.6	30.4	40.7	8.9
1988	18.2	19.7	37.9	16.7	7.6

28. Games to help students practice words, skills, or concepts.

% SURVEY	never	rarely	sometimes	most of time	always
1989	8.2	11.2	40.3	31.3	9.0
1988	12.1	19.7	48.5	15.2	4.5

29. Programs that explain (tutor) concepts or methods.

% SURVEY	never	rarely	sometimes	most of time	always
1989	12.8	16.5	41.4	27.1	2.3
1988	13.6	22.7	40.9	18.2	4.5

30. Simulations for learning or using concepts and skills in a situation.

% SURVEY	never	rarely	sometimes	most of time	always
1989	11.5	12.3	52.3	19.2	4.6
1988	19.7	21.2	33.3	22.7	3.0

31. Programs that give students problem-solving tasks or discovery learning activities.

% SURVEY	never	rarely	sometimes	most of time	always
1989	11.2	14.2	46.3	22.1	5.2
1988	12.1	16.7	42.4	24.2	4.5

32. Programs that let students make pictures, graphics, and music.

% SURVEY	never	rarely	sometimes	most of time	always
1989	40.7	18.5	34.1	5.2	1.5
1988	29.5	37.2	15.7	11.1	6.5

33. Programs that do calculations or help solve math problems.

% SURVEY	never	rarely	sometimes	most of time	always
1989	20.5	9.8	27.3	31.1	11.4
1988	31.8	22.7	18.2	15.2	10.6

34. Word-processing software or programs that help with writing.

% SURVEY	never	rarely	sometimes	most of time	always
1989	35.2	18.0	30.5	11.7	4.7
1988	12.1	12.1	16.7	33.3	25.8

35. A programming language, like BASIC, for students to write their own programs.

% SURVEY	never	rarely	sometimes	most of time	always
1989	78.3	12.4	3.9	1.6	3.9
1988	62.1	13.6	12.1	4.5	4.5

36. Programs that provide database searching and research assistance.

% SURVEY	never	rarely	sometimes	most of time	always
1989	57.1	19.8	19.8	3.2	
1988	53.0	10.6	13.6	15.2	4.5

37. What would you estimate is the average response time to load instructional materials?

% SURVEY	< 1 min	1-3 mins	4-6 mins	7-10 mins	> 10 mins
1989	20.1	59.0	14.9	3.7	2.2
1988	20.0	35.4	24.6	13.8	6.2
1987	6.9	43.5	29.8	9.9	9.9

38. In the past school year, how many times have you experienced equipment failure?

% SURVEY	0-5	6-10	11-15	16-20	> 20
1989	89.7	8.8	.7		.7
1988	71.2	12.1	10.6	3.0	3.0
1987	70.3	16.7	5.8	2.2	5.1

39. On the average, how much time expired before equipment failure problems were resolved?

% SURVEY	minutes	hours	days	weeks	months
1989	61.9	17.5	17.5	3.2	
1988	50.8	24.6	14.8	6.6	3.3
1987	36.5	27.0	26.2	6.3	4.0

40. What has been the format of your training?

% SURVEY	lecture 7 <	lecture 8 >	hands on 7 <	hands on 8 >	tutoring
1989	5.3	3.0	26.3	54.9	10.5
1988	3.0	7.5	44.8	32.8	10.4
1987	6.5	6.5	27.4	48.4	11.3

41. How much time per semester have you spent in formal training?

% SURVEY	< 1 day	1-5 days	6-10 days	11-15 days	> 15 days
1989	47.8	41.2	6.6	2.9	1.5
1988	50.0	42.6		2.9	2.9

42. For how many minutes on the average does any one student usually use a given computer program at any one session?

% SURVEY	10 mins	20 mins	30 mins	40 mins	50+ mins
1989	2.9	11.8	44.9	38.2	2.2
1988		10.4	23.9	61.2	3.0

43. When was the most recent occasion that some students in your class did computer work during class time?

% SURVEY	3 days	3 days 2 wks	2 wks 3 wks	> 3 wks	never
1989	40.6	25.6	5.3	21.8	6.8
1988	36.4	24.2	7.6	31.8	

44. Which of the rules for apportioning time do you think is most commonly used by teachers at the school?

% SURVEY	equal time	> time slower	> for work completed	> don't own PC	> for interested
1989	85.5	9.2	2.3		3.1
1988	86.6	1.5	4.5		7.5
1987	77.4	6.0	9.8		6.8

45. How many students work at any one computer at one time?

% SURVEY	one student	one plus tutoring	one with watching	pair	more than two
1989	62.7	3.0	9.0	24.6	.7
1988	76.1		4.5	17.9	1.5
1987	77.0	2.2	7.4	11.9	1.5

46. Which of the methods for apportioning time do you think is best for use at school

% SURVEY	equal time	> time slower	> for work completed	> don't own PC	> for interested
1989	83.7	9.6	.7	.7	5.2
1988	82.1	9.0		1.5	7.5
1987	85.2	8.1	2.2	.7	3.7

47. Introducing students to the subject.

% SURVEY	computer	traditional	same
1989	11.1	69.6	19.3
1988	13.4	68.7	17.9
1987	16.3	62.2	21.5

48. Providing a large variety of examples to illustrate and/or clarify concepts.

% SURVEY	computer	traditional	same
1989	60.8	22.3	16.9
1988	55.2	25.4	16.4
1987	63.7	20.7	15.6

49. Covering the material rapidly.

% SURVEY	computer	traditional	same
1989	51.2	27.9	20.9
1988	51.5	21.2	21.2
1987	52.9	28.7	18.4

50. Teaching to students of different abilities.

% SURVEY	computer	traditional	same
1989	68.5	16.9	14.6
1988	50.7	16.4	26.9
1987	66.2	17.6	16.2

51. Providing remedial assistance.

% SURVEY	computer	traditional	same
1989	72.4	12.2	15.4
1988	62.1	13.6	18.2
1987	69.4	16.4	14.2

52. The apparent level of enthusiasm of computer-using students for school in general has.

% SURVEY	decreased	unchanged	increased
1989	1.5	14.9	83.6
1988	1.5	18.2	80.3
1987	2.9	16.9	80.1

53. Special opportunities for students with learning disabilities or handicaps have.

% SURVEY	decreased	unchanged	increased
1989	.8	28.8	70.5
1988		41.5	58.5
1987	4.6	22.3	73.1

54. Special opportunities for the academically gifted have.

% SURVEY	decreased	unchanged	increased
1989	2.3	33.3	64.4
1988		37.9	62.1
1987		20.8	79.2

55. Learning in regular school subjects by average students has.

% SURVEY	decreased	unchanged	increased
1989	2.3	42.1	55.6
1988		54.5	45.5
1987		43.3	56.7

56. Learning in regular school subjects by below-average students has.

% SURVEY	decreased	unchanged	increased
1989	1.5	29.8	68.7
1988		46.3	53.7
1987	.8	34.1	65.2

57. Students working successfully on their own without direct supervision from the teacher has.

% SURVEY	decreased	unchanged	increased
1989	3.7	23.9	72.4
1988	4.5	22.4	73.1
1987	2.3	30.1	67.7

58. Students taking the lead in helping other students with their questions has.

% SURVEY	decreased	unchanged	increased
1989	1.5	38.1	60.4
1988	6.1	33.3	60.6
1987	7.0	46.5	46.5

59. Students being given assignments specifically tailored to their prior performance has.

% SURVEY	decreased	unchanged	increased
1989	3.0	47.0	50.0
1988	3.1	55.4	41.5
1987	10.2	43.0	46.9

60. Diagnoses of students' learning problems and misunderstandings have.

% SURVEY	decreased	unchanged	increased
1989	4.5	60.2	35.3
1988	4.6	69.2	24.6
1987	9.4	51.6	39.1

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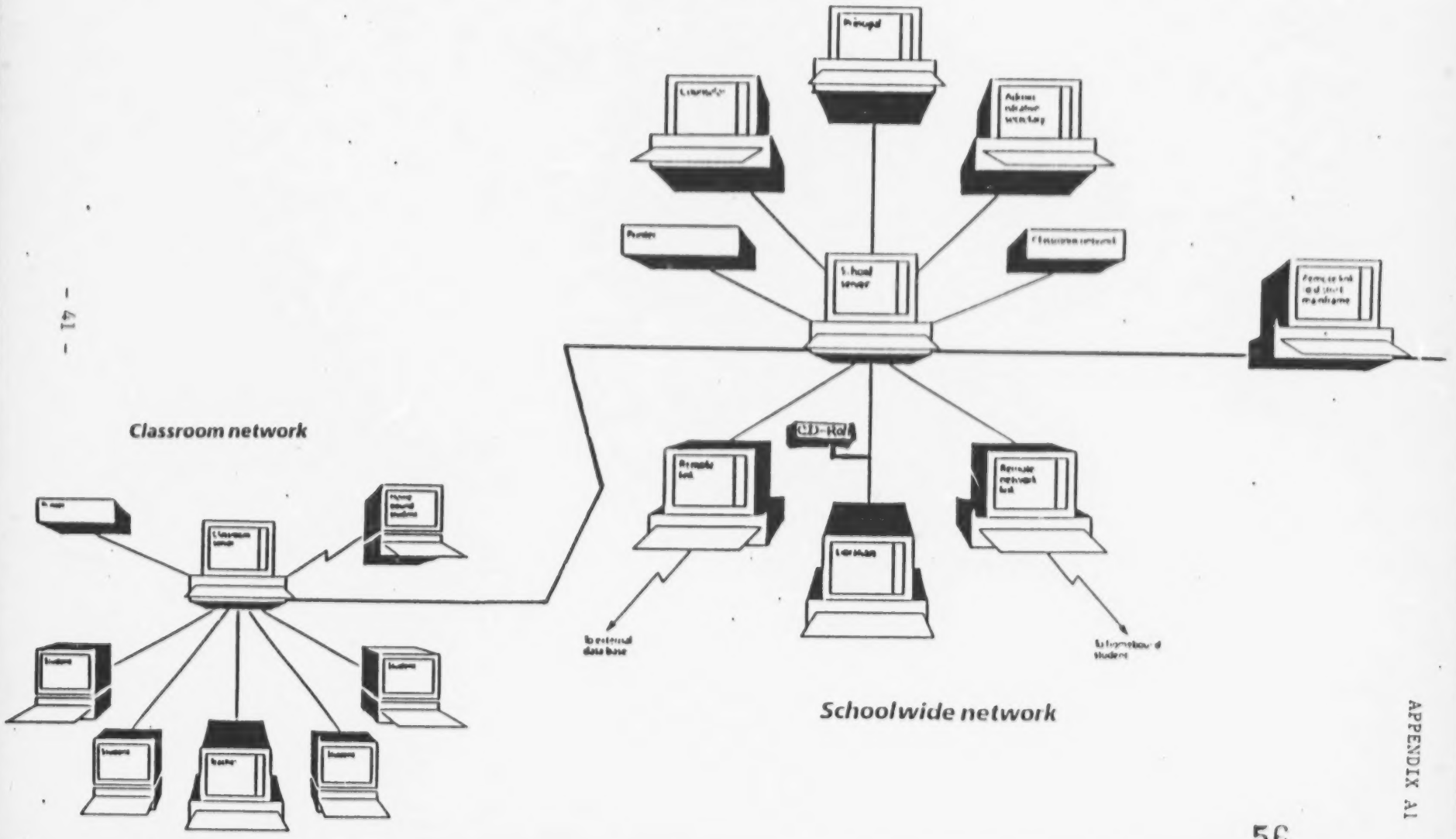
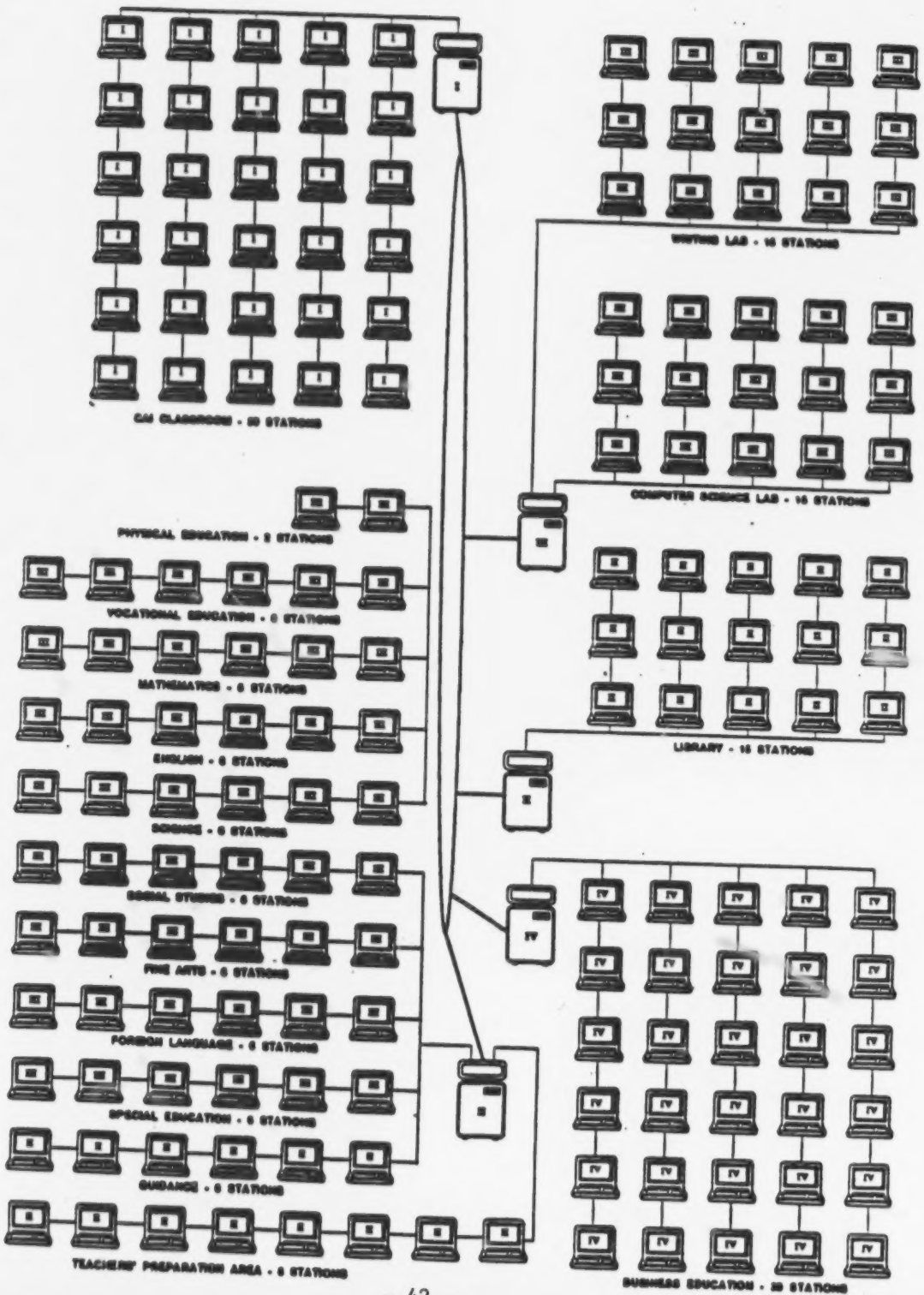
Networking—support for the classroom and the school



SOUTHERN HIGH SCHOOL

INSTRUCTIONAL COMPUTER PLAN


I
II
III
IV
WRITING LAB - 16 STATIONS
COMPUTER SCIENCE LAB - 16 STATIONS
LIBRARY - 16 STATIONS
BUSINESS EDUCATION - 30 STATIONS
PHYSICAL EDUCATION - 2 STATIONS
VOCATIONAL EDUCATION - 0 STATIONS
MATHEMATICS - 0 STATIONS
ENGLISH - 0 STATIONS
SCIENCE - 0 STATIONS
SOCIAL STUDIES - 0 STATIONS
FINE ARTS - 0 STATIONS
FOREIGN LANGUAGE - 0 STATIONS
SPECIAL EDUCATION - 0 STATIONS
GUIDANCE - 0 STATIONS
TEACHERS' PREPARATION AREA - 0 STATIONS